Ontario Geological Survey

Northern Ontario
Engineering Geology Terrain Study 52

# STRATTON AREA

## (NTS 52D/NE)

## District of Rainy River

by

D.R. Hallett and M.A. Roed

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## MAP
## (accompanying report)

Map 5068 (coloured) – Northern Ontario Engineering Geology Terrain Study, Data Base Map, Stratton (NTS 52D/NE). Scale 1:100 000.

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by

D. R. Hallett[1] and M. A. Roed[2]

## 1.0 INTRODUCTION:

This report and the accompanying map present the results of an engineering geology terrain study for the Stratton area, District of Rainy River. The area, which covers NTS block 52D/NE, lies between Latitudes 48°38′N and 49°00′N and Longitudes 94°00′W and 94°43′W. The report and map form part of a series of publications which provide similar terrain data for approximately 370 000 km$^2$ of northern Ontario.

The purpose of this study is to provide an inventory of engineering geology terrain conditions that will serve as a basic data framework for engineering and resource planning activities, at a level of detail consistent with a scale of 1:100 000. The terrain information is contained on the Data Base Map (OGS Map 5068, accompanying this report).

Interpretation of 1974 black and white aerial photographs, at a scale of approximately 1:50 000, formed the basis of the terrain mapping process.

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The interpretation was compared to relevant published information for the study area. In addition, two automobile field trips were conducted in 1978, an early reconnaissance trip to identify major terrain units and a later one to verify the airphoto interpretation. Thus, the map represents a reconnaissance overview of the engineering conditions of the terrain.

An engineering terrain legend was developed to facilitate the mapping and to provide a common information base for the entire map series. This legend is shown on the accompanying Data Base Map. Further discussion on the mapping techniques, legend format, and possible uses of this engineering geology information is available in the Ontario Engineering Geology Terrain Study Users' Manual (Gartner, Mollard, and Roed, in preparation), a companion publication to this series of maps and reports.

Appreciation is expressed to the Ontario Geological Survey for providing a manuscript copy of the aggregate inventory map for the area, prepared by E. V. Sado.

## 2.0 GEOLOGIC SETTING:

The Stratton area is underlain by Precambrian crystalline rocks which are covered by a discontinuous mantle of unconsolidated Quaternary deposits. The area is dominated by a thick glaciolacustrine plain composed of silt and clay, and extensive organic peat terrain. Numerous glaciolacustrine sand and gravel beaches are also present. Rock terrain rises above the plain in the northeastern part of the area.

### 2.1 BEDROCK GEOLOGY:

The Stratton area is situated on the western edge of the Canadian Shield and contains two main groups of crystalline rocks, both of Archean age. This part of the Shield belongs to the Wabigoon Belt of the Superior Structural Province.

The oldest group of rocks consists of metamorphosed basaltic and andesitic massive lavas, which lie beneath Quaternary deposits throughout the southern half of the map-area. Metasediments and granitic

plutons also occur here. The northern portion is dominated by a younger group of rocks, composed of granite and granitic gneiss in batholiths and isolated plutons. Numerous diabase dikes of Proterozoic age cut the older rocks in the southeast corner of the area (Davies and Pryslak 1967).

Mineral potential throughout the map-area is rated as medium or low, except for a small patch of felsic metavolcanics on the eastern boundary where potential is high, particularly for base metals (Springer 1978).

## 2.2 QUATERNARY GEOLOGY:

Northwestern Ontario was affected by several stages of continental glaciation during the Pleistocene. However, only the deposits of the last glaciation, the Laurentide of Wisconsinan age, are preserved in the Stratton area. The ice began to advance approximately 100 000 years ago and travelled as far south as central Wisconsin before receding. The ice disappeared from the Stratton area approximately 15 000 years ago. The till which underlies most of the map-area is associated with a glacial advance from the northeast during the Late Wisconsinan. On the basis of striations, Blackburn (1976) inferred that a weak advance from the northwest occurred after the one from the northeast. Zoltai (1961) gives a more complete glacial history of the region.

Widespread stagnation of the ice mass resulted in the deposition of a variety of surficial materials (Zoltai 1961, 1965). Till was deposited directly by the ice in the form of ground moraine. Meltwater from the glacier formed glaciofluvial deposits that now occur mainly in the subsurface. Ponded meltwater accumulated in lowlands to form glacial lakes. These lakes grew in size, eventually resulting in an enormous body of water called Glacial Lake Agassiz. Two phases of this glacial lake have been recognized by Johnston (1915) from exposures along the shore of Lake of the Woods. Widespread deposits of glaciolacustrine silt and clay occur throughout the Rainy River lowland. In some localities, bedrock hills were swept clean of unconsolidated material during high water stages of Glacial Lake Agassiz, as evidenced by numerous bare bedrock knobs in the northeastern part of the map-area; however, most of the bedrock topography was completely covered by the lake deposits.

The complete disappearance of glacial ice and the gradual draining or drying up of glacial lakes marked the end of the Pleistocene Stage of the Quaternary Period in this area. Since that time, approximately 9 000 years ago (Prest 1970), Rainy River has been incised into the plain, other streams developed alluvial flood plains, spits and bars formed in the Lake of the Woods, and organic deposits accumulated in large, flat, wet depressions. These deposits are nonglacial in origin, and together with the various glacial materials, comprise the variety of Quaternary unconsolidated deposits that forms a discontinuous mantle over the bedrock in the Stratton area.

## 2.3 PHYSIOGRAPHY:

The glaciolacustrine and organic plain, known as the Rainy River lowland, occupies most of the map-area. It is very flat except for beach ridges. Elevations vary from about 335 to 365 m above sea level. Rock terrain in the northeastern part of the area is of low to moderate relief. Elevations here vary from about 335 to 390 m. Rainy River forms the International Boundary along the southern margin of the area and occupies a narrow channel incised into the plain. Lake of the Woods, at an elevation of 323 m, borders the northwestern part of the area where extensive offshore bars have developed to form the Sable Islands.

# 3.0 ENGINEERING TERRAIN UNITS:

Engineering terrain units are composed of a combination of various materials (unconsolidated and/or bedrock) which form recognizable landforms with certain engineering characteristics. Major terrain unit groups, and the engineering significance of each, are discussed in detail. These include bedrock terrain (RN), glaciolacustrine deposits (LP, LB), organic terrain (OT), and alluvial deposits (AP). Other terrain units, such as ground moraine (MG), glaciofluvial outwash (GO), and eolian deposits (ED) occur as subordinate landforms in the major terrain units and are discussed in less detail. Figure 1 is a diagrammatic sketch of a typical terrain setting. Table 1 summarizes the characteristics and engineering significance of the terrain units in the Stratton area.

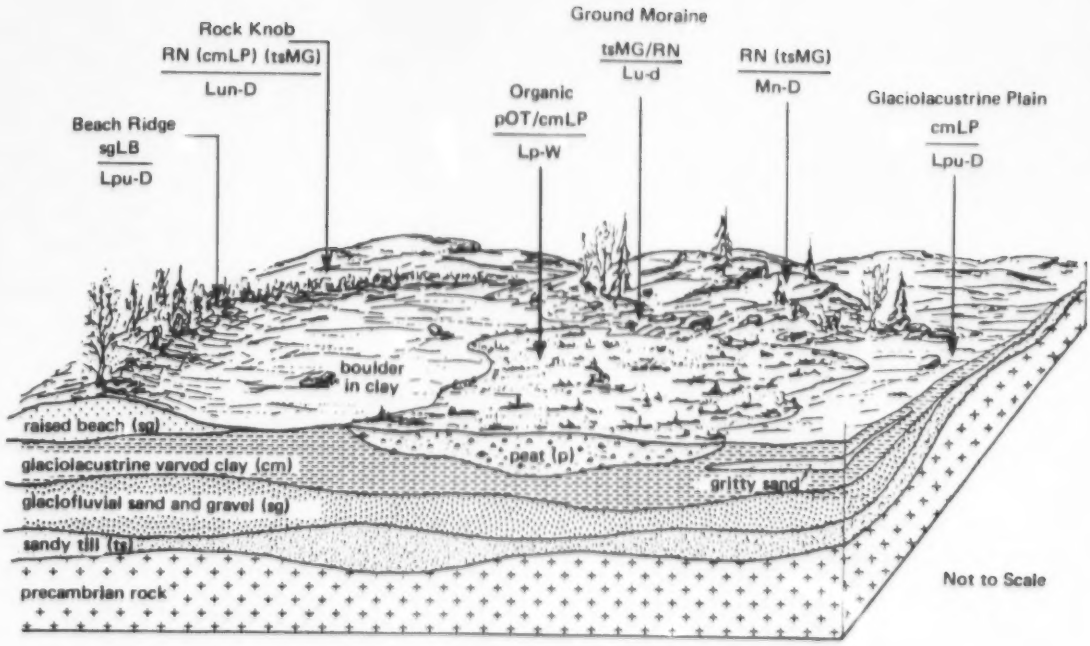


**FIGURE 1 – DIAGRAMMATIC SKETCH SHOWING TYPICAL TERRAIN TYPES AND THEIR REPRESENTATIVE LETTER SYMBOLS.**

**TABLE 1** SUMMARY OF TERRAIN UNIT CHARACTERISTICS AND ENGINEERING SIGNIFICANCE, STRATTON AREA.

| CLASSIFICATION | | ENGINEERING USE | | | | |
|---|---|---|---|---|---|---|
| **Terrain Unit and Location** | **Material; Relief; Topography; Drainage** | **General Construction** | **Transportation Routes** | **Waste Disposal** | **Groundwater Supply** | **Major Constraints** |
| **BEDROCK TERRAIN (RN)**, in the northeastern part of the area | rock; low to moderate relief; rugged to undulating; dry | excavations necessary for most construction | expensive excavations and fill required; aggregate must be imported | high pollution potential | deep wells necessary; poor to fair | blasting required; aggregate must be imported |
| **GLACIOLACUSTRINE PLAIN (LP)**, throughout area | silt and clay (mc); low relief; planar; dry | easy excavations; frost susceptible; slope instability | aggregate must be imported | suitable for waste disposal where deposits are thick and groundwater table low | large diameter shallow wells for domestic use; poor to fair | slope instability; erosion; frost susceptibility; low strength |
| **GLACIOLACUSTRINE BEACHES (LB)**, throughout area | sand and gravel (sg); low relief; ridged and knobby; dry | excellent conditions | aggregate is readily available | good, if deposit is surrounded and underlain by clay and silt | poor | poor quality and limited quantity |
| **ORGANIC TERRAIN (OT)**, throughout area | peat (p); low relief; planar; wet | highly frost susceptible; highly compressible; low bearing capacity | unsuitable subgrade except for light vehicle roads | pollution potential is high | quality and quantity of water are poor | low strength; poor drainage; frost susceptible |
| **ALLUVIAL PLAINS (AP)**, along streams | silt, clay and peat (mcp); low relief; planar; wet | frost susceptible; low bearing capacity | unsuitable subgrade; poor drainage | potential stream pollution | quality of water is poor | poor drainage; frost susceptible |

Comments: Glaciofluvial outwash sand and gravel (sgGO) occurs below clay and silt in places close to the Rainy River. Ground moraine till (tsMG) occurs in association with bedrock terrain. Till-like material occurs within the glaciolacustrine clay and is not differentiated in this interpretation.

## 3.1 BEDROCK:

Examples:

$$\frac{\text{RN(tsMG)(cmLP)}}{\text{Mnjw-D(M)}} \qquad \frac{\text{RN(cmLP)(tsMG)}}{\text{Lnuw-D}}$$

Nearly bare bedrock knobs (RN) are the dominant landform in the northeastern corner of the map-area. Relief is moderate (M), ranging from 15 to 60 m, and the topographic character is usually rugged (j) and/or knobby (n). Ground moraine (MG) composed of sandy till (ts) occurs as a thin discontinuous mantle overlying the bedrock and is thickest in the valleys and on the sides of hills. Glaciolacustrine clay and silt deposits (cmLP) occur at lower elevations in this terrain. The entire unit appears to have been wave washed (w) by glacial lake action. Drainage is dry (D), except in some bedrock depressions where it is mixed (M), either wet or dry. Toward the southwest, the rock knobs become more subdued and undulating (u), with relief being less than 15 metres (L).

The principal engineering significance of bedrock terrain is that it is difficult to excavate. Blasting is required for all subsurface excavations. Due to the rugged topography, extensive cuts that require blasting are necessary for transportation route construction, in order to eliminate extreme horizontal and vertical alignments. High, rugged slopes pose additional problems for general construction activities. Although there are small sand and gravel deposits in rock terrain that provide some construction material for low-grade access roads, major transportation routes may require importation of suitable granular material.

Groundwater potential is generally poor, except in fault zones where it may be possible to obtain substantial quantities of water. Bedrock terrain is not suitable for the installation and operation of septic drain tile fields, except where there is a thick layer (at least 1.5 m) of associated till, clay, or sand. The unit is not suitable for near-surface solid or hazardous waste disposal.

## 3.2 GROUND MORAINE:

Example:

$$\frac{\text{RN(tsMG)(cmLP)}}{\text{Mnjw-D(M)}}$$

Ground moraine (MG) composed of sandy till (ts) occurs as a thin mantle overlying bedrock at higher elevations, mainly in the northeastern part of the map-area. Ground moraine has not been mapped as a dominant terrain unit in this area. The engineering significance of the sandy bouldery till is limited because of its thin, discontinuous nature. The till is used as a construction material for forest access roads. Groundwater potential is poor. The unit may be suitable for waste disposal.

## 3.3 GLACIOFLUVIAL:

Example:

$$\frac{\text{cmLP/sgGO}}{\text{Lu-D}}$$

Glaciofluvial sand and gravel (sgGO) occur in various parts of the area, but only in the subsurface. Deposits are overlain by glaciolacustrine clay (cmLP) and are suspected to be large in some places; however, detailed subsurface exploration would be required to determine the character and extent of these deposits.

The major engineering significance of the sand and gravel is its potential for use as a construction material. Groundwater potential is excellent in this material, and a number of existing wells tap this aquifer for a water supply. The unit is not suitable for waste disposal as the permeability is high.

## 3.4 GLACIOLACUSTRINE:

Glaciolacustrine terrain is composed of two distinct landforms; plains and beaches, as described below.

### 3.4.1 Glaciolacustrine Plains:

Examples:

$$\frac{\text{cmLP/RN(sLB)(pOT)}}{\text{Lpd-D(D)(W)}} \qquad \frac{\text{cmLP(pOT)}}{\text{Lp-D(W)}}$$

$$\frac{\text{cmLP/RP(RN)}}{\text{Lup-D}} \qquad \frac{\text{sLP}}{\text{Lp-Dh}}$$

Glaciolacustrine clay and silt deposits (cmLP), representative of deposition in Glacial Lake Agassiz II (Johnston 1915), occur throughout the Stratton area and are generally varved. In many places, thin beds and lenses of gravel and sand occur. Also, isolated boulders are scattered throughout the area. This terrain unit is till-like in many places and could be the calcareous till referred to by Johnston (1915) and Hills and Morwick (1944). Further discrimination is not possible at this scale of airphoto interpretation. Deposits are thick in places, ranging from 10 to 20 m in the southwest, and thin out over planar bedrock in the middle of the map-area. Near Lake of the Woods and along the Rainy River, the glaciolacustrine deposits appear to be more sandy (s). Commonly associated subordinate landforms include bedrock knobs and plains (RN, RP), organic terrain (OT), and glaciolacustrine beaches (LB). Eolian sand dunes (sED) also occur in minor pockets close to the Sable Islands in the northwestern part of the area.

The glaciolacustrine plain is generally dry; however, at times of heavy precipitation or rapid snow melt in the spring, flooding may occur because of flat slopes, slow runoff, and the relatively low permeability of the materials. The fine-grained deposits of silt and clay are poor construction materials.

Although the occurrence of occasional gritty layers can improve the strength parameters, glaciolacustrine deposits are generally weak and have low bearing capacity and shearing resistance. Small landslides have occurred along the Rainy River, and minor slumping and erosion are evident along most streams. These are important considerations in the design and construction of bridges and buildings on or near steep slopes.

Transportation route construction and general near-surface construction are inexpensive because of the ease of excavation. However, due to the high percentage of silt, the deposits are frost-susceptible. Aggregate may have to be imported.

Although the moisture content of the silt and clay is very high, groundwater potential is poor due to the low effective permeability and porosity of the unit. The terrain is suitable for construction of oversized septic drain tile fields and is generally suitable for waste disposal. The soil would be difficult to work when frozen.

### 3.4.2 Glaciolacustrine Beaches:

Examples:

$$\frac{\text{sgLB(cmLP)(RN)}}{\text{Lpn-D}} \qquad \frac{\text{sgLB(RN)}}{\text{Lpu-D}}$$

Extensive glaciolacustrine beaches (LB) composed of sand and gravel (sg) occur in long, relatively narrow, even-crested, curvilinear ridges to the north of the town of Rainy River and the village of Sleeman. Beach ridges generally vary in height from 1 to 5 m (Johnston 1915) and in width from 15 to 150 m. Many other beaches are scattered throughout the area, both on surface and beneath organic deposits. Glaciolacustrine clay and silt underlie the beach deposits, and rock knobs are also found.

Sand and gravel beach deposits offer the best potential for local aggregate supplies in the Stratton map-area. Transportation routes are easily constructed on or near the ridges due to the availability of granular material and low relief of the unit. Beach deposits also provide good foundation conditions.

Groundwater potential in the beach deposits is poor, as most beaches occur above the water table. However, where the water table is high, groundwater potential in beach deposits is excellent. Where the beach ridges are underlain and surrounded by silt and clay, the unit is suitable for near-surface waste disposal.

## 3.5 RECENT LAKE DEPOSITS:

Example:

$$\frac{\text{sLP}}{\text{Lp-Dh}}$$

Recent lake deposits occur as sand bars in Lake of the Woods, known as the Sable Islands, and as a prominent spit known as Windy Point. Fine-grained sand deposits are presently being deposited at these locations. Relief is low. Surface drainage is dry (D), but the water table is high (h).

## 3.6 ALLUVIAL:

Examples:

$$\frac{\text{mpAP}}{\text{Lp-W}} \qquad \frac{\text{mcAP}}{\text{Lp-Mh}} \qquad \frac{\text{smAP(cmLP)/sgGO}}{\text{Lt-D}}$$

Alluvial plains (AP) occur along major streams, such as the Rainy, Pinewood, Sturgeon, Kishkakoesis and Splitrock Rivers. Deposits consist of silt (m), peat (p), clay (c), and sand (s). Relief is low and planar (Lp), and the drainage conditions are either wet (W) or mixed with a high water table (Mh). Some alluvial deposits occur as terraces above flood level along the Rainy River and consist of sand and silt in association with glaciolacustrine silt and clay. These deposits (e.g. near Pinewood in the southern part of the area) are underlain by sand and gravel of glaciofluvial origin and are dry.

Alluvial plains are unsuitable for most engineering uses due to poor drainage, a high water table, and/or periodic flooding. Terraces are underlain by sand and gravel and have potential as important aggregate sources. The terraces are well drained.

Groundwater potential is considered poor, since most of the alluvium in the map-area is fine grained. The unit is not suitable for waste disposal because of the potential for pollution of the associated stream.

## 3.7 ORGANIC:

Examples:

$$\frac{\text{pOT/cmLP}}{\text{Lp-W}} \qquad \frac{\text{pOT(scLP)}}{\text{Lp-Mh}}$$

Extensive tracts of organic terrain (OT) composed primarily of peat (p) occur in the Stratton area. The deposits are at least 1 m thick and are suspected to be very thick in places. In most cases, it is apparent that the organic terrain is underlain by deposits of glaciolacustrine origin. Subdued glaciolacustrine features, such as beaches and pits, can be distinguished below the peat by means of vegetation differences where the peat is thin; however, these underlying deposits have not been mapped. Relief is low (L) and drainage conditions are wet (W) or mixed with a high water table (Mh).

Construction is difficult and expensive in organic terrain due to the poor drainage conditions and the low strength, low bearing capacity, high compressibility, and extremely high frost susceptibility of the soil materials. Although peat is generally poor for engineering or construction use, light vehicle roads can be built with some success across dryer parts of the deposits.

Groundwater potential is low and any water is likely to have a high content of organic iron. The terrain is not suitable for any type of waste disposal.

Some peat deposits, especially near the edges of bogs, have been reclaimed for agriculture through extensive ditching. Turf industries have utilized the organic deposits in the past, but perhaps the greatest potential for the unit is as a fossil fuel source, since reserves are suspected to be large.

## 3.8 EOLIAN:

Example:

$$\frac{\text{scLP/RP(sED)}}{\text{Lpu-D}}$$

Wind-blown sand occurs in poorly defined dunes (sED) close to the shoreline of Lake of the Woods in the western part of the map-area. Deposits are not extensive and have been mapped in association with other terrain units. The sand is fine grained and is not an important engineering material. In terms of recreation, it is considered a sensitive unit due to its low trafficability and susceptibility to erosion.

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